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Ko et al.

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(54) **ANTENNA ASSEMBLY**

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H01Q 13/10	(2006.01)
H01Q 1/24	(2006.01)
H01Q 1/48	(2006.01)
H01Q 9/04	(2006.01)

(52) **U.S. Cl.**

CPC ***H01Q 13/106*** (2013.01); ***H01Q 1/243*** (2013.01); ***H01Q 1/38*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 9/0421*** (2013.01)

(58) **Field of Classification Search**

USPC ..... 343/700 MS, 702, 767, 846

See application file for complete search history.

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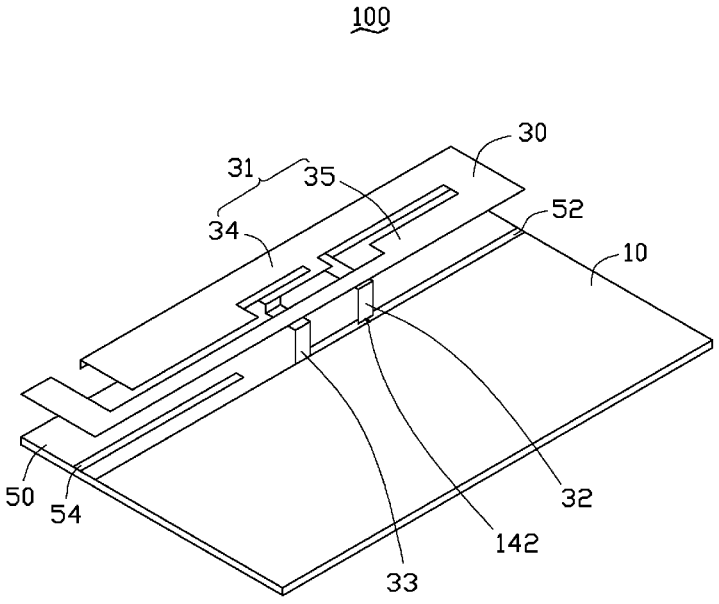
(57) **ABSTRACT**

An antenna assembly includes a carrier, a metal sheet, and an antenna. The metal sheet is attached to the carrier and defining at least one notch. The antenna is connected to the metal sheet and includes a radio body for receiving and transmitting wireless signals. The radio body is positioned above the metal sheet. The length of current path in a peripheral wall of the at least one notch is in a predetermined proportion to the wavelength of the wireless signals, enabling the metal sheet to resonate with the radio body to increase the bandwidth of the antenna.

16 Claims, 4 Drawing Sheets



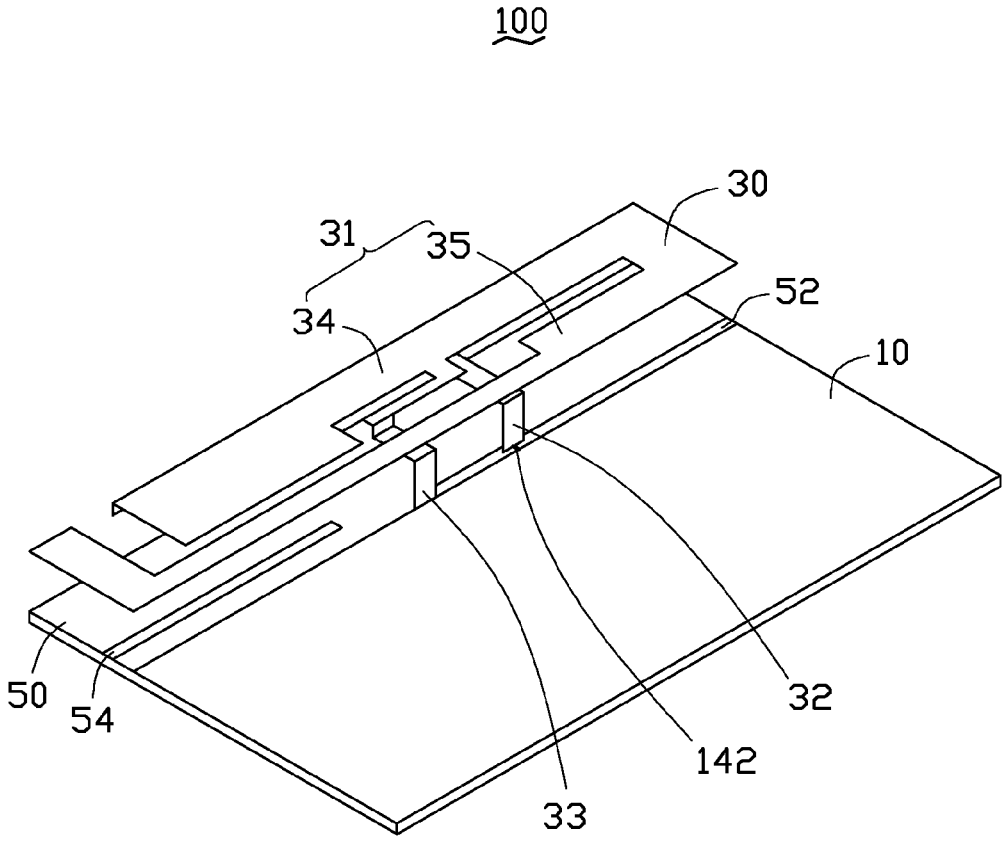
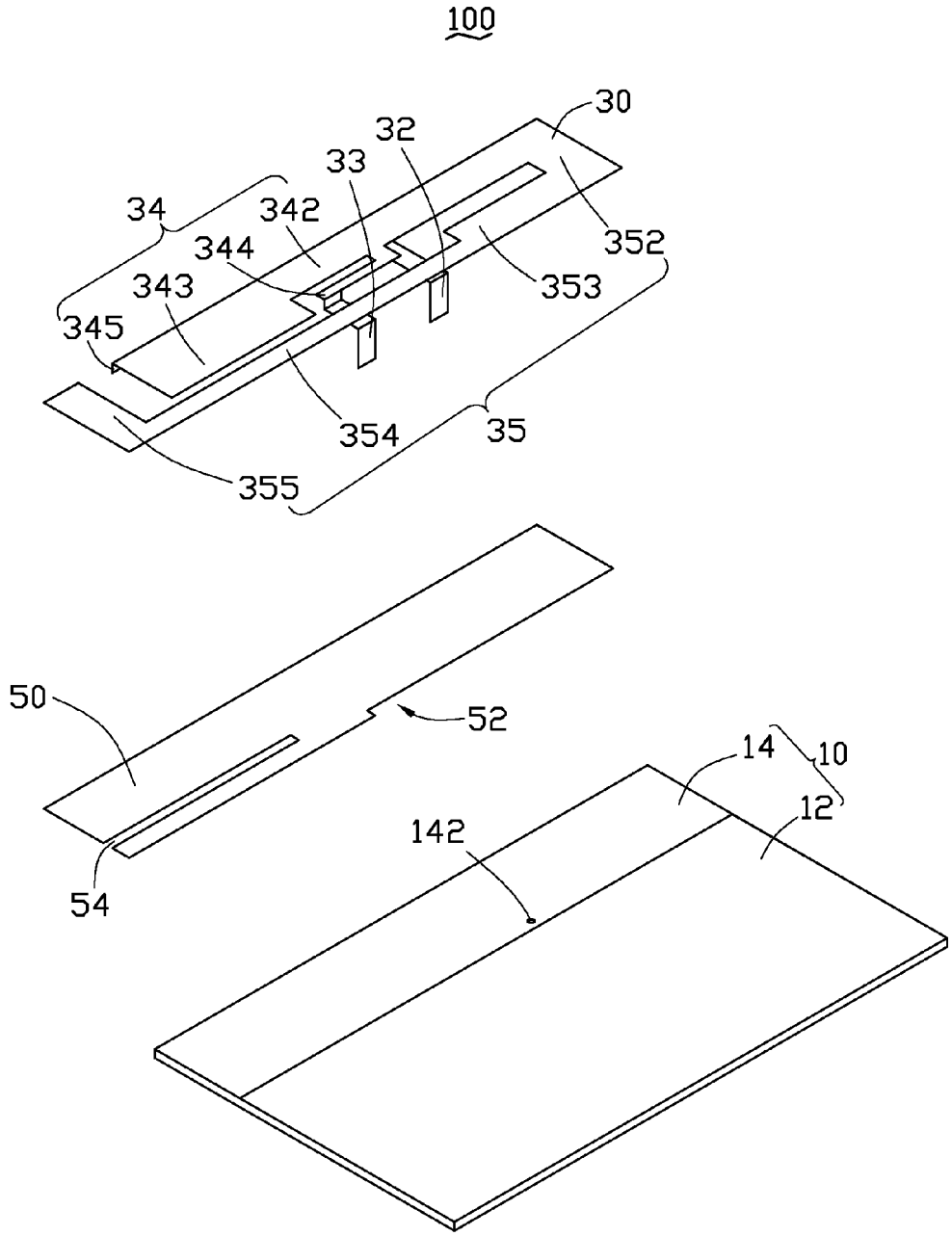


FIG. 1


100
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32
33
34
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14
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12
142
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FIG. 2

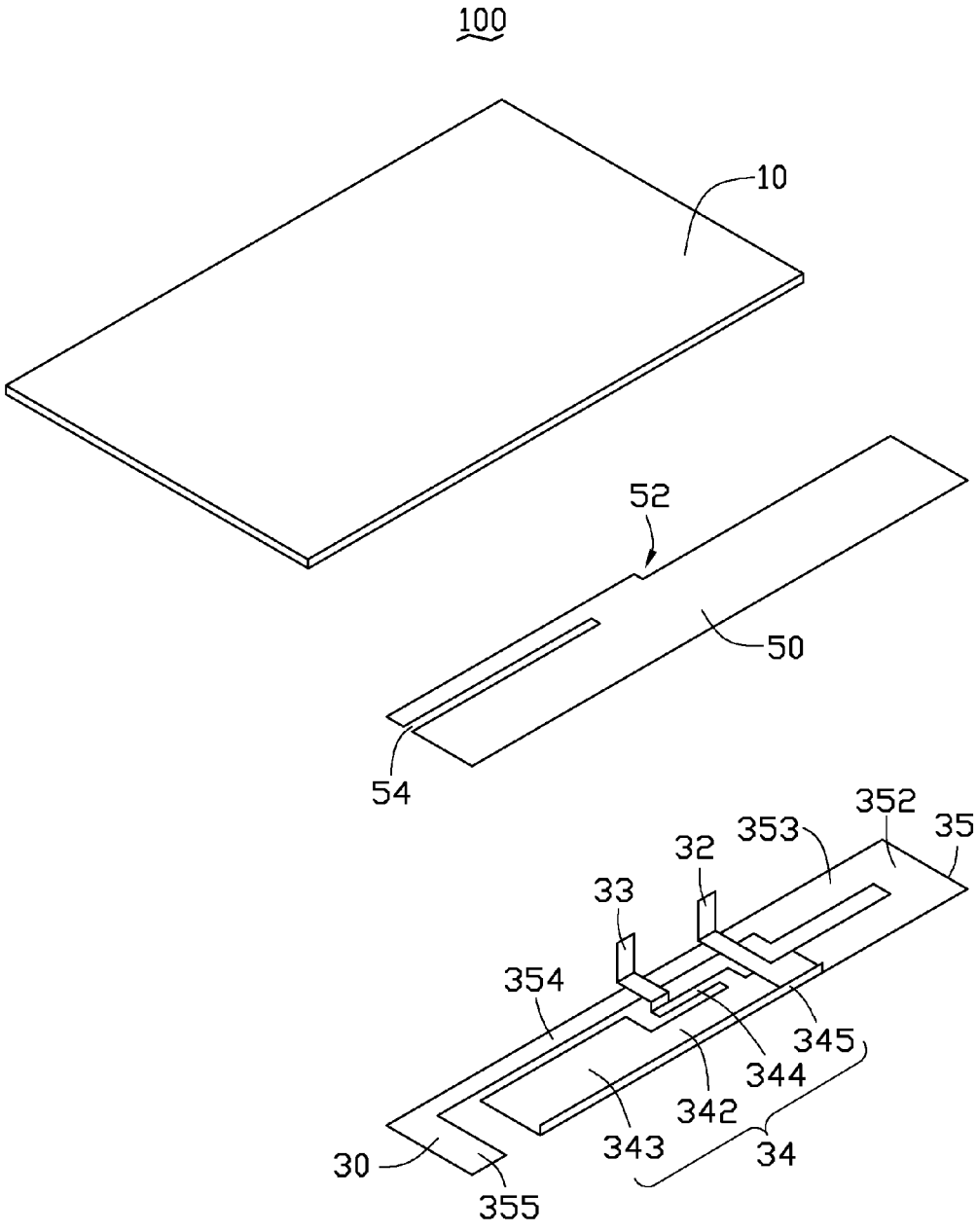

FIG. 3

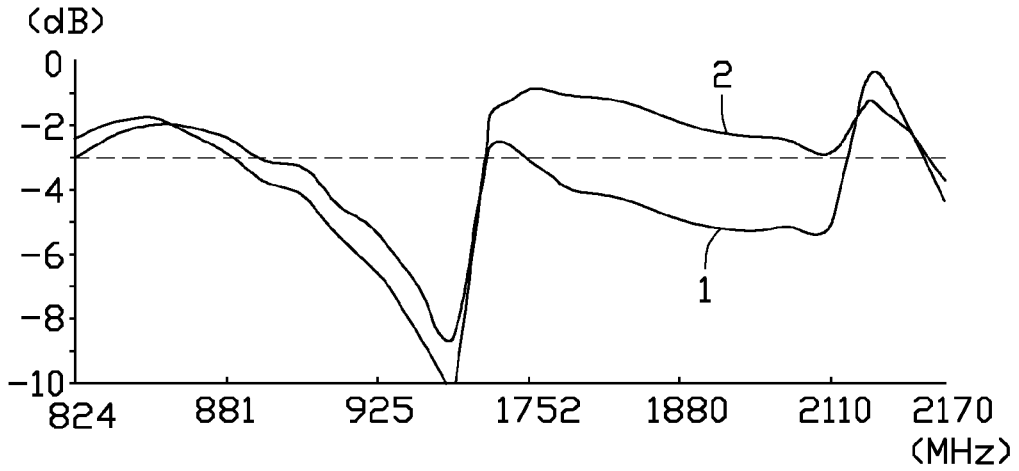

FIG. 4

ANTENNA ASSEMBLY

BACKGROUND

1. Technical Field

The present disclosure relates to antenna assemblies.

2. Description of related art

Antennas are important elements of wireless communication devices, such as mobile phones. The bandwidth of the antennas is an important factor that affects the efficiency of receiving and transmitting signals of the antennas. However, structures of the antennas are limited by the interior space of the wireless communication devices. Thus, it is a great challenge to improve the bandwidth of antennas under the condition of not changing so much on the structures of the antennas.

Therefore, there is room for improvement within the art.

BRIEF DESCRIPTION OF THE DRAWINGS

Many aspects of the disclosure can be better understood with reference to the drawings. The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the disclosure. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the views.

FIG. **1** is an assembled, isometric view of an antenna assembly in accordance with an exemplary embodiment.

FIG. **2** is an exploded view of the antenna assembly of FIG. **1**.

FIG. **3** is an exploded view of the antenna assembly of FIG. **1** viewed from another angle.

FIG. **4** is a return loss graph of the antenna assembly of FIG. **1**.

DETAILED DESCRIPTION

FIG. **1** shows an antenna assembly **100** incorporated in a wireless communication device, such as a mobile phone or a personal digital assistant.

The antenna assembly **100** includes a carrier **10**, an antenna **30**, and a metal sheet **50**. The antenna **30** and the metal sheet **50** both are attached to the carrier **10**.

Referring to FIG. **2** and FIG. **3**, the carrier **10** may be a printed circuit board of the wireless communication device incorporating the antenna assembly **100**. The carrier **10** includes a grounding area **12**, grounding the antenna assembly **100**, and a clearance zone **14**, adjacent to the grounding area **12**. The clearance zone **14** can also be known in the art as a "keep out zone," and the like. The purpose of clearance zone **14** is to not permit other elements on the carrier **10** to be placed in a predetermined area to interfere the antenna **30**. In the exemplary embodiment, the clearance zone **14** is located at an end of the carrier **10**. The clearance zone **14** has a feed point **142** configured for feeding current into the antenna **30**.

In the exemplary embodiment, the antenna **30** is a dual-band antenna. The antenna **30** is positioned opposite to the clearance zone **14**. The antenna **30** includes a radiating body **31**, a feed terminal **32**, and a grounding terminal **33**. The radiating body **31** includes a first radiating portion **34** and a second radiating portion **35**.

The first radiating portion **34** includes a first main section **342**, a second main section **343**, a first extending section **344**, and a second extending section **345**. Both the first and second main sections **342**, **343** are substantially rectangular. The second main section **343** connects with an end of the first main section **342** and has a width greater than the width of the first main section **342**. The second main section **343** has a first edge aligned with a first edge of the first main section **342**. The first extending section **344** is coplanar with the first and second main sections **342**, **343**. The first extending section **344** is substantially L-shaped. A first end of the first extending section **344** connects with a second edge of the first main section **342** opposite to the first edge of the first main section **342**. A second end of the first extending section **344** extends perpendicularly from the first end and extends towards the second main section **343**. The second extending section **345** extends from the first edge of the first main section **342** and the first edge of the second main section **343** and bends to be perpendicular to the first main section **342** (or the second main section **343**). The first radiating portion **34** can be used to receive and transmit wireless signals having a first central frequency of about 1900 MHz.

The second radiating portion **35** is coplanar with the first main section **342** of first radiating portion **34**. The second radiating portion **35** includes a first connecting section **352**, a second connecting section **353**, a third connecting section **354**, and a forth connecting section **355**. The first connecting section **352** extends perpendicularly from an end of the first main section **342** furthest from the second main section **343**. The second connecting section **353** extends perpendicularly from the first connecting section **352** and extends towards the second main section **343**. The third connecting section **354** connects with the second connecting section **353** and extends towards the second main section **343** to beyond the second main section **343**. The forth connecting section **355** extends perpendicularly from the third connecting section **354**. The second radiating portion **35** can be used to receive and transmit a second wireless signal having a central frequency of about 900 MHz.

The feed terminal **32** is substantially L-shaped. The feed terminal **32** extends perpendicularly from the second extending section **345** and extends towards the second radiating portion **35**, and then bends towards the carrier **10**, to electrically connect with the feed point **142** in the clearance zone **14**. The grounding terminal **33** extends perpendicularly from the first extending section **344**, and then bends towards the carrier **10**, to electrically connect with the metal sheet **50**.

The metal sheet **50** has a size substantially equal to the area of the clearance zone **14** and is attached to the clearance zone **14**. The metal sheet **50** is electrically connected to the grounding area **12**, to be a ground reference of the antenna **30**. When the grounding terminal **33** is connected to the metal sheet **50**, the metal sheet **50** grounds the antenna **30**. The metal sheet **50** defines a first notch **52** and a second notch **54**. The first notch **52** is defined at en edge proximate to the grounding area **12**. When the metal sheet **50** is attached to the clearance zone **14**, the feed point **142** is aligned with the first notch **52** to be exposed from the first notch **52**. The second notch **54** is defined through an end of the metal sheet **50** and extends along a direction parallel to the first notch **52**. The total length of the current path in a first notch peripheral wall of the first notch **52** and in a second notch peripheral wall of the second notch **54** is in a predetermined proportion to the wavelength of the signals received and transmitted by the first radiating portion **34**. Thus, the metal sheet **50** resonates with the first radiating portion **34** to increase the bandwidth of the high frequency band (e.g., 1900 MHz band).

When electrical current flows in the feed terminal **32**, the radiating body **31**, the grounding terminal **33**, the metal sheet **50**, and the grounding area **12**, to form a current loop, the antenna assembly **100** receives and transmits the first wireless signal having a high frequency and the second wireless signal having a low frequency. In this case, a current is induced in the

metal sheet **50**. The existence of the first and second notches **52**, **54** enables the induced current in the metal sheet **50** to couple with current in the first radiating portion **34**, thus enabling the metal sheet **50** to resonate with the first radiating portion **34**.

Referring to FIG. **4**, the curve **2** shows a return loss (RL) graph of the antenna assembly **100** without the metal sheet **50**. The curve **1** shows a RL graph of the antenna assembly **100** having the metal sheet **50** defining the first and second notches **52**, **54**. It is shown that the antenna assembly **100** with the metal sheet **50** defining the first and second notches **52**, **54** has an obvious increased bandwidth of the high frequency band.

The antenna **30** is not limited to a dual-band antenna. The antenna **30** can also be a single band antenna or multi-band antenna. Correspondingly, the antenna **30** is not limited to the structure described above.

The metal sheet **50** can also have only the first notch **52** or the second notch **54**. Furthermore, the shapes of the first notch **52** and the second notch **54** can also be changed, as long as the notch(es) defined on the metal sheet **50** has a peripheral wall length in a predetermined proportion to the wavelength of signals which need an increase in bandwidth.

The antenna assembly **100** has the metal sheet **50** attached to the clearance zone **14** of the carrier **10**. The metal sheet **50** defines the first and second notches **52**, **54**, enabling the metal sheet **50** to be cable of the antenna **30**, thus increasing the bandwidth of the antenna **30** and improving the efficiency of receiving and transmitting signals of the antenna **30**. Furthermore, the metal sheet **50** is positioned on the clearance zone **14** of the carrier **10**, effectively utilizing the clearance zone **14** and occupying no extra space of the carrier **10** or the wireless communication device incorporating the antenna assembly **100**.

It is to be understood, however, that even through numerous characteristics and advantages of the present disclosure have been set forth in the foregoing description, together with details of assembly and function, the disclosure is illustrative only, and changes may be made in detail, especially in the matters of shape, size, and arrangement of parts within the principles of the disclosure to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. An antenna assembly, comprising:

a carrier;

a metal sheet, the metal sheet is attached to the carrier and defines at least one notch; and

an antenna, the antenna is connected to the metal sheet and comprises a feed terminal, a grounding terminal, and a radiating body for receiving and transmitting wireless signals, the radiating body is positioned above the metal sheet; the radiating body comprising a first radiating portion and a second radiating portion, the first radiating portion comprising at least one main section, a first extending section, and a second extending section;

wherein length of current path in a peripheral wall of the at least one notch is in a predetermined proportion to the wavelength of the wireless signals, enabling the metal sheet to resonate with the radiating body;

the first extending section and the at least one main section are coplanar, the second extending section is perpendicular to the at least one main section; the feed terminal perpendicularly extends from the second extending section and parallel to the at least one main section, and then extends towards the second radiating portion, and then bends towards the carrier; the grounding terminal perpendicularly extends from the first extending section, and perpendicularly bends towards the second radiating portion, and then perpendicularly bends towards the carrier.

2. The antenna assembly as claimed in claim **1**, wherein the carrier comprises a clearance zone; and the metal sheet is attached to the clearance zone.

3. The antenna assembly as claimed in claim **2**, wherein the carrier comprises a grounding area for grounding the antenna; and the metal sheet is electrically connected to the grounding area.

4. The antenna assembly as claimed in claim **3**, wherein the carrier has a feed point; and the feed terminal is electrically connected to the feed point.

5. The antenna assembly as claimed in claim **4**, wherein the feed point is located in the clearance zone and is aligned with the at least one notch, thus the feed point is uncovered by and is accessible via the at least one notch.

6. The antenna assembly as claimed in claim **3**, wherein the grounding terminal is electrically connected to the metal sheet.

7. The antenna assembly as claimed in claim **1**, wherein the first radiating portion is configured for receiving and transmitting wireless signals having a first central frequency and the second radiating portion is configured for receiving and transmitting wireless signals having a second central frequency; and the length of current path in the peripheral wall of the at least one notch is in a predetermined proportion to the wavelength of the wireless signals having the first central frequency.

8. An antenna assembly, comprising:

a carrier;

a metal sheet, the metal sheet is attached to the carrier and defines a first notch and a second notch; and

an antenna positioned opposite to the metal sheet, the antenna comprises a feed terminal, a grounding terminal, a first radiating portion for receiving and transmitting wireless signals having a first central frequency and a second radiating portion for receiving and transmitting wireless signals having a second central frequency;

wherein a total length of current path in a first notch peripheral wall of the first notch and in a second notch peripheral wall of the second notch is in a predetermined proportion to the wavelength of the wireless signals having the first central frequency, enabling the metal sheet to resonate with the first radiating portion;

wherein the first extending section and the at least one main section are coplanar, the second extending section is perpendicular to the at least one main section; the feed terminal perpendicularly extends from the second extending section and parallel to the at least one main section, and then extends towards the second radiating portion, and then bends towards the carrier; the grounding terminal perpendicularly extends from the first extending section, and perpendicularly bends towards the second radiating portion, and then perpendicularly bends towards the carrier.

9. The antenna assembly as claimed in claim **8**, wherein the carrier comprises a clearance zone; and the metal sheet is attached to the clearance zone.

10. The antenna assembly as claimed in claim **9**, wherein the carrier comprises a grounding area for grounding the antenna; and the metal sheet is electrically connected to the grounding area.

11. The antenna assembly as claimed in claim **10**, wherein the carrier has a feed point; and the feed terminal is electrically connected with the feed point.

12. The antenna assembly as claimed in claim 11, wherein the feed point is located in the clearance zone and is aligned with the first notch, thus the feed point is uncovered by and is accessible via the first notch.

13. The antenna assembly as claimed in claim 10, wherein grounding terminal electrically connects with the metal sheet.

14. The antenna assembly as claimed in claim 10, wherein the first notch is defined at an edge proximate to the grounding area; and the second notch is defined through an end of the metal sheet and extends along a direction parallel to the first notch.

15. The antenna assembly as claimed in claim 14, wherein the first radiating portion comprises a first main section and a second main section; the second main section connects with an end of the first main section; a first end of the first extending section connects with the first main section; a second end of the first extending section extends perpendicularly from the first end and extends towards the second main section; the second extending section connects with a same side of the first main section and the second main section and bends to be perpendicular to the first main section.

16. The antenna assembly as claimed in claim 15, wherein the second radiating portion comprises a first connecting section, a second connecting section, a third connecting section, and a fourth connecting section; the first connecting section connects with the first main section; the second connecting section extends perpendicularly from the first connecting section and extends towards the second main section; the third connecting section connects with the second connecting section and extends towards the second main section to beyond the second main section; the fourth connecting section extends perpendicularly from the third connecting section.

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